

49 An Ounce of Prevention



As you first learned in Activity 46, “Disease Fighters,” your immune system recognizes and fights disease-causing microbes. Most people are able to fight off diseases like colds or the flu quickly and return to full health within a week or so. Other diseases, like diphtheria, are more severe. Such diseases are much more likely to have serious effects, or even lead to death, in a larger portion of the population.



How can you fight serious diseases that often overwhelm human immune systems? One approach, **vaccination** (vak-suh-NAY-shun), is very effective in preventing some diseases. Each **vaccine** works against a specific disease. Vaccines are available against diseases caused by both viruses and bacteria. There are also vaccines being developed to work against other microbes as well.

CHALLENGE



How do vaccines prevent disease?

MATERIALS



For each student

- 1 Student Sheet 49.1, “Intra-act Discussion: An Ounce of Prevention”
Student Sheet 45.1, “Anticipation Guide: Diseases and Prevention,” from Activity 45

PROCEDURE



1. Discuss your own experiences with vaccines and antibiotics.
2. Assign a role for each person in your group. Assuming that there are four people in your group, each of you will read one role in Scene 1 and another role in Scene 2.

Roles in Scene 1

Student
Parent
Older sibling (sister or brother)
Grandparent

Roles in Scene 2

Student
Parent
Doctor
Nurse

3. Read the role play on the next pages aloud. Insert the names of your group members as directed.

ACT OR REACT!

Scene 1: At the dinner table

- Parent: It's getting to be flu season. My boss wants all employees to get flu shots. She doesn't want us to miss work and get behind on our deadlines.
- Older Sibling: Funny you should mention that. My friend at school was just telling me that he has been feeling sick and thinks he has the flu. How does a flu shot stop you from getting sick?
- Grandparent: A flu shot is a vaccine that helps your body resist the flu.
- Student: Oh, I know about vaccines. I had a measles vaccine when I was a little kid and then you took me to get a booster shot just last year.
- Parent: That reminds me—it's time for your tetanus booster.
- Student: Another shot? I hate shots.
- Parent: Yes, the immunity from some vaccines begins to wear off after a while, so you need a booster—it gives your immune system a boost.
- Student: Why do I need to get all of these shots? And how does a vaccine work anyway?
- Older Sibling: A vaccine is a dead or weakened form of a microbe or a part of the microbe. It helps your immune system prepare in advance to fight off the disease-causing germs.
- Student: You mean they actually inject you with the disease microbe?
- Older Sibling: Yup! The microbe is first inactivated, so it doesn't make you sick.
- Student: Do vaccines work only against diseases caused by viruses, like the flu?

Grandparent: I don't think so. There are vaccines against tetanus and diphtheria, and they are caused by bacteria, not viruses. When my mother and father were very young, their parents worried that they would get tetanus, or "lock-jaw," as they called it, every time they got a deep cut. They didn't have tetanus shots then.

Student: So you're saying that all vaccines work to keep you from getting a disease, but not all diseases are caused by the same thing.

Parent: Exactly. The way in which vaccines work is the same for different diseases, but each disease is caused by a different microbe, or germ. A microbe can be a bacterium or a virus.

Student: Then what's the difference between bacteria and viruses?

Older Sibling: This is exactly what we're studying in science class! Bacteria are living cells that grow and divide. Viruses can't grow or divide unless they inject their genetic material into another cell.

Grandparent: (*Name of Older Sibling*), what do you mean by "genetic material"?

Older Sibling: Oh, that just means DNA. You've probably heard of DNA.

Student: I've heard of DNA. Viruses have DNA?

Parent: Yes, I read about this. Viruses have a small amount of DNA, or sometimes a similar substance called RNA, as their genetic material. They also have an outer coat that protects the material inside, but that's about it. They infect cells and cause the infected cells to make new copies of the virus. But if a virus can't get into a living cell, no copies are made and the virus can't reproduce.

Student: How do they make a vaccine? Why doesn't it make you sick?

Grandparent: I don't know about all vaccines, but I do remember polio vaccines. Polio was a common disease when I was young. In fact, President Franklin D. Roosevelt became paralyzed from the waist down when he caught polio as an adult. He hid from the public how serious it was, perhaps because of people's attitudes toward disabilities at the time.

Chemicals or heat were used to inactivate the polio virus and it was then injected into a healthy person. As (*Name of Older Sibling*) said, the inactivated virus didn't make you sick. But your immune system was tricked into getting ready to fight off an infectious polio virus.



President Franklin Delano Roosevelt

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- Parent: The polio vaccine is the only vaccine I know of that you can take orally. They used to put it on a sugar cube. The weakened virus wouldn't make you sick, but would still cause you to become immune.
- Grandparent: I remember the first polio vaccine. It was a shot. My little brother hated it, but my mother was so relieved not to have to worry that we might get polio. It was a very serious threat back then. Vaccines have almost wiped out some diseases like polio and smallpox.
- Student: Wow, until today, I never thought about life before vaccines.

Scene 2: In the doctor's office

- Nurse: Dr. (*Last name of Doctor*), here's your next patient.
- Doctor: Hello (*Name of Student*), what seems to be the problem? Not feeling well?
- Student: I think I have the flu.
- Doctor: (*checking pulse*) Hmm . . . let's see. What are your symptoms?
- Student: Well, I've been coughing a lot and my throat's sore. . . .
I've been really tired. And I'm also starting to have a hard time breathing.
- Parent: I think there's a fever, too.
- Doctor: (*to Student*) Open your mouth and let's take a look. (*Doctor examines Student's throat, listens to chest cough, and takes temperature.*) Well, it could be the flu. But I'm not sure. You might have strep throat or pneumonia (new-MOW-nyah) or just a really bad cold. We'll have to take a chest x-ray and a throat culture.
- Parent: Are you going to prescribe an **antibiotic** (an-tih-by-AH-tik)?
- Doctor: Not yet.
- Parent: Why not?
- Nurse: Because if you have the flu, an antibiotic won't work. The flu is a viral disease, as are some types of pneumonia.
- Parent: I'm sorry, but I don't understand. I thought it was standard practice to prescribe an antibiotic. I always get one when I have the flu or a sore throat.
- Doctor: Nurse (*Name of Nurse*), why don't you explain while I give (*Name of Student*) a chest x-ray and throat culture?
(Student leaves with doctor.)
- Nurse: Good idea. Antibiotics are medications that are used to fight bacterial diseases. This is because bacteria are living organisms that are killed by the action of an antibiotic.
- Parent: They always tell you to take the entire prescription.

- Nurse: Right. It takes time to kill the entire population of bacteria in your body. If you stop taking the antibiotic before all the disease-causing bacteria are gone, you run the risk of having them increase again.
- Parent: So why don't antibiotics work on diseases caused by viruses?
- Nurse: Because of the fact that viruses are not cells. They can reproduce only by entering your cells and using the cells to reproduce. That makes them harder to attack. . . . Oh, here's (*Name of Student*), back from the x-ray room.
(*Doctor and Student return.*)
- Student: Hey (*Mom/Dad*), my X-ray was negative, so I don't have pneumonia. I hope I don't have to take antibiotics. I hate swallowing pills!
- Parent: Doctor, why don't you just go ahead and give us an antibiotic? The nurse just said that antibiotics are the way to treat bacterial diseases.
- Doctor: That's right, but unless a throat culture or X-ray is positive, (*Name of Student*) probably doesn't have a bacterial infection. And it isn't helpful to take antibiotics that are not needed.
- Student: But the last time I had the flu, you prescribed an antibiotic.
- Doctor: That's right. But if I recall correctly, the last time you were here, your little sister was also sick—and she had a bacterial infection. You seemed to have the early symptoms of her infection. So the antibiotics were intended to treat the bacterial infection.
- Student: (*interrupting*) . . . and not to cure the flu! So how do you cure the flu?
- Nurse: There is no cure for the flu. Medicines you take when you have the flu or a cold only relieve the symptoms, like fever or headache. But they can't make you well; they can just make you feel better. In fact, there is no cure for most viral diseases.
- Parent: What about flu shots?
- Student: (*Mom/Dad*), you told me that flu shots prevent you from getting the flu. They don't make you better.
- Doctor: That's right. Unfortunately, although flu shots prevent the flu in most cases, they don't work in every case. Why, just this morning we had a lady in the office who had gotten a flu shot, but who still caught the flu. It seems that she was infected with a different type of the flu than the one she had received a vaccine for.
- Nurse: May I suggest that you take (*Name of Student*) home? We'll call you in the morning; by then we'll know if (*Name of Student*) needs an antibiotic.
- Student: Yeah, I need to lie down. My head hurts from all this stuff. Maybe I'll ask my science teacher more when I feel better.

ANALYSIS

-  1. Fill in the “After” column for Statements 8–10 on Sheet 45.1, “Anticipation Guide: Diseases and Prevention.” Did your thinking change?
2. Mark whether you agree or disagree with the statements on Student Sheet 49.1, “Intra-act Discussion: An Ounce of Prevention.”
 - Predict what you think other members of your group will say.
 - Discuss the statements with your group.
-  3. A vaccine prevents a person from catching an infectious disease; it does not treat the disease after the person has caught it. What are some advantages of preventing, rather than treating, infectious diseases?
4. Why are serious side effects from vaccines very rare?
5. You go to the doctor and find out that you may have the flu. Would you expect to be prescribed an antibiotic? Explain your answer.
-  6. Do you think that vaccinations against the flu should be required? Explain. Support your answer with evidence and identify the trade-offs of your decision.

Hint: To write a complete answer, first state your opinion. Provide two or more pieces of evidence that support your opinion. Then consider all sides of the issue and identify the trade-offs of your decision.
7. **Reflection:** Explain whether you would change your answer to Question 4 if the disease had more severe symptoms and a greater chance of causing death.

EXTENSION

The vaccines for polio were developed in the 1950s. Find out more about how this disease affected society by asking different generations of your family, such as your parents and grandparents, if they can recall knowing anyone who had polio.